Analysis of Existing versus Historic Condition for Structural Stages and Potential Vegetation Groups within the Malheur, Umatilla, and Wallowa-Whitman National Forests

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Introduction

This paper summarizes the existing and historic abundance of structural stages and potential vegetation groups found on public lands managed by the Malheur, Umatilla, and Wallowa-Whitman National Forests within the Blue Mountains in northeastern Oregon. Site specific project level analysis teams can use this data to identify areas where treatments are appropriate to move landscapes closer to the desired mix of structural stages. This report was originally produced in August 2006. Recent completion of modeling using the vegetation dynamics development tool (VDDT) produced new estimates of the historic range of variability (HRV), which triggered the need to update the comparison of the existing condition to the HRV estimates. This update also includes the change from biophysical settings to the new term called potential vegetation groups, which was a result of the revision team responding to comments on the draft revised forest plan.

Site-specific, project-level work will need to follow existing Forest Plan direction including the plan amendment commonly known as the Eastside Screens (USDA 1995) unless this direction is modified through a plan amendment or revision. Site-specific projects that have sound rational for deviating from the Eastside Screens can utilize the site-specific forest plan amendment process as needed. See Regional Forester's letter dated June 11, 2003 for examples of cases in which harvest in old forest or removal of trees greater than 21 inches diameter breast height (DBH) may better meet desired conditions (Appendix C). Project teams should work with the Regional Screens Team if a site-specific Forest Plan amendment is needed, to insure that the amendment can be supported through appeal and litigation.

The existing condition data is used as a baseline against which to measure progress towards attaining desired conditions on the three national forests, and in particular, desired conditions for late and old-structured stands. **The departure between the existing condition and the estimated historical landscape prior to 1850 is summarized in this report.** The departure analysis will be used to help identify those areas that are most at risk of losing critical ecosystem elements, and where vegetation management may be useful in preserving or developing those elements. Data for this analysis comes from existing vegetation polygon information collected at a variety of scales. Data sources include walk-through examinations, photo-interpretation, remote sensing, intensive stand examinations, and most similar neighbor (MSN) modeling. Data can be considered current as of 2004-2005.

The data from this analysis indicate that there appear to be opportunities within some potential vegetation groups to move multi-strata old forest and mid age multi-story forest towards the old forest single story condition. The dry single story old forest (below HRV) and the mid age multi-strata, understory reinitiation forest (above HRV) are those conditions that are the most departed from historic levels.

Description of Potential vegetation groups

Potential vegetation groups are aggregations of plant associations found in the Blue Mountains (Powell et al. 2007, Johnson 1987, 1992, 2005) and represent a combination of temperature and moisture regimes. See Appendix A for a complete description. The potential vegetation groups represent areas on the landscape that have evolved with similar disturbance histories and which will respond to management in a similar manner. Knowing which processes formed these settings, as well as relationships to the associated plant and animal species found in theses settings, allows us to establish desired conditions and monitoring elements specific to local conditions. The Blue Mountains potential vegetation groups have been cross-walked to classifications used in National level fire regime-condition class (FRCC) and Johnson and O'Neil wildlife habitat relationships of Oregon and Washington protocols.

The cold forest potential vegetation groups contain high elevation forests of subalpine fir and whitebark pine. These forests historically burned infrequently, with mixed intensities. The cold

forests group can contain subalpine fir, Englemann spruce, grand fir, and lodgepole pine and is typified by large, infrequent and high intensity fires when the right series of extreme weather events aligned with the drying out of fuels. The cold forest can also have very small, almost single tree, lightning caused fires when the fuels are damp. The moist forests can contain grand fir, western larch, lodgepole pine, Englemann spruce, Douglas-fir, and ponderosa pine. These types historically had the most complex and variable fire history and stand structures, as a result of mixed intensity fires at highly variable frequency and sizes. The dry forest potential vegetation group had ponderosa pine, Douglas-fir, and grand fir species composition that was maintained in a relatively open condition by large, frequent, and low intensity fire.

Structural Stages

Structural stages are described in O'Hara (1996), Oliver (1996), and Hessburg and other (1999) (PNW-GTR-458). See Appendix B for the data parameters that were used to classify each vegetation polygon into a structural stage. The following structural classification is similar to what was used in the Interior Columbia Basin Ecosystem Management Project. This classification system has been cross-walked to classification systems developed for National level FRCC and Johnson and O'Neil wildlife habitat relationships of Oregon and Washington.

Stand initiation (SI): Growing space is reoccupied following fire or other stand-replacing disturbances.
Stem exclusion (SE): Establishment of new trees is precluded by lack of sunlight or moisture. This stage generally consists of a continuous single layer of trees and can vary from small trees up to those approaching 21 inches in diameter.
Understory reinitiation (UR): A second tree layer is established under an older overstory. Overstory mortality has created growing space for new understory trees.
Old forest single story (OFSS): A predominance of large trees is present in the stand. Only one canopy layer is present. The definition of a large tree varies depending on the productive potential of the site. This stage is often maintained by frequent and low intensity fires.
Old forest multi story (OFMS): A predominance of large trees is present in the stand. Two or more canopy layers are present. The definition of a large tree varies depending on the productive potential of the site.

Existing Condition for Structural Stages and Potential vegetation groups

The Blue Mountains are dominated by forested settings (80 percent), with an additional 20 percent comprised of shrubland, herbland, and non-vegetated (rock, water) settings (Table 1). The forested environment in the Blue Mountains is dominated by the dry potential vegetation group (62 percent), followed by the moist setting at 24 percent and 14 percent in the cold forest setting (Table 2). The percentage of forested potential vegetation groups varies by national forest (Table 2), with the Malheur National Forest having the lowest percent in cold and the highest percent in the dry setting. The Umatilla National Forest with a Columbia River maritime influence on the north end of the forest, has the highest share of moist environment of the three forests. The Wallowa-Whitman National Forest is dominated by dry forest but also has significant areas of moist and cold forest.

TABLE 1 - PERCENT TOTALS FOR ALL POTENTIAL VEGETATION GROUPS				
Potential Vegetation Group	**Malheur NF**	**Umatilla NF**	**Wallowa-Whitman NF**	**Total Blue Mountains NFs (weighted by acres)**
Cold forest	9	8	18	13
Moist forest	6	31	18	17
Dry forest	72	43	34	47
Juniper woodland	3	1	1	1
Cool/Cold Riparian Forest	<1	0	0	<1
Warm Riparian Forest	<1	<1	<1	<1
Dry herbland	2	13	15	11
Dry shrubland	6	1	2	3
Cold shrubland	<1	<1	1	<1
Cold herbland	<1	<1	2	<1
Moist herbland	<1	1	3	<1
Moist shrubland	<1	2	1	<1
Warm Riparian herbland	1	<1	<1	<1
Warm Riparian shrubland	<1	<1	<1	<1
Cool/Cold Riparian herbland	<1	0	<1	<1
Cool/Cold Riparian shrubland	<1	0	0	<1
Non-vegetated	<1	<1	5	2

TABLE 2- FORESTED POTENTIAL VEGETATION GROUPS (PERCENT of TOTAL FORESTED ACRES)				
Potential Vegetation Group	**Malheur NF**	**Umatilla NF**	**Wallowa-Whitman NF**	**Total Blue Mountains NFs (weighted by acres)**
Cold forest	11	10	25	16
Moist forest	6	38	26	22
Dry forest	83	52	49	62

TABLE 3- PERCENT STRUCTURAL STAGE (BASED ON TOTAL FORESTED ACRES)				
Structural Stage	**Malheur NF**	**Umatilla NF**	**Wallowa-Whitman NF**	**Total Blue Mountains NFs (weighted by acres)**
Stand initiation	8	12	14	11
Stem exclusion	17	20	15	17
Understory reinitiation	52	38	51	49
Old forest multi-story	21	19	19	20
Old forest single story	2	10	1	3

Old forest stands (OFMS and OFSS) are dominated by multi-layered conditions at 20 percent, with only 3 percent in the old forest single-story category (Table 3). The breakdown of old forest varies between national forests, ranging from 20 percent on the Wallowa-Whitman to 29 percent on the Umatilla.

The distribution of old forest varies by potential vegetation group and structural condition (Table 4) with multi-story (OFMS) being more abundant than single story old forest (OFSS). The distribution of old forest within each potential vegetation group also varies by national forest. Most of the dry setting old forest is located on the Malheur, which has 23 percent in this category. Most of the moist old forest is located in the Umatilla, with 53 percent. The Wallowa-Whitman has the highest percent of cold forest.

TABLE 4 – PERCENT OLD FOREST FOR EACH VEGETATION GROUP								
Potential Vegetation Group	**Malheur NF**		**Umatilla NF**		**Wallowa-Whitman NF**		**Total Blue Mountains NFs (weighted by acres)**	
	OFSS	**OFMS**	**OFSS**	**OFMS**	**OFSS**	**OFMS**	**OFSS**	**OFMS**
Cold forest	1	16	1	28	1	30	1	26
Moist forest	4	42	22	31	1	23	10	29
Dry forest	3	21	4	8	1	12	2	15

Development of the Historic Range of Variability Estimates

Ranges for estimates of the historic range of variability (HRV) for structural stages were developed through modeling using the vegetation dynamics development tool (VDDT) model in 2007 (Table 5). Models were developed for 7 forested types(cold forest, whitebark pine, moist forest, dry ponderosa, dry grand fir, dry Douglas-fir, hot dry pine); which were combined into 3 potential vegetation groups (cold, moist, and dry forest) for the purpose of developing the forest plan.

The VDDT model, which is a non-spatial state and transition model, was used to estimate historic (pre 1860) forested conditions in the Blues. The “states” within the model are described by combinations of vegetation structure and composition including: structural stage, species composition, number of tree layers, stand density (canopy closure), and tree diameter. The combinations of structure and composition for all of the models produced 403 different states. The “transitions” part of the model describes how stands move between the different “states” through time. The transitions are described as either deterministic or probabilistic. Deterministic transitions are those that occur due to stand growth as stands move through time. Probabilistic transitions are those that occur due to disturbances such as fire, insects, and disease. Probabilities and time intervals for the probabilistic transitions were developed through literature searches, expert opinion, and modeling using current vegetation survey (CVS) data run through the forest vegetation simulator (FVS). Results were summarized over a 300 year time period for 30 different runs of the model. The figures in Table 5 show the mean value for the 300 year time period, as well as the range which was calculated by using 2 standard deviations around the mean. The figures for the dry forest are a weighted average of the results for the individual dry forest models described above.

TABLE 5 - ESTIMATED HISTORIC RANGES FOR STRUCTURAL STAGES (Percent range and mid-point within each potential vegetation group)					
Potential vegetation group	**Stand Initiation**	**Stem Exclusion**	**Understory Reinitiation**	**Old Forest Single-story**	**Old Forest Multistory**
Cold forest	32 (20-43)	22 (13-31)	19 (11-26)	13(5-20)	15 (8-23)
Moist forest	26 (19-32)	25 (20-29)	18 (14-23)	15 (12-18)	18 (15-22)
Dry Forest	21 (13-28)	16 (10-22)	3 (0-7)	52 (41-63)	8 (1-17)

Departure Analysis

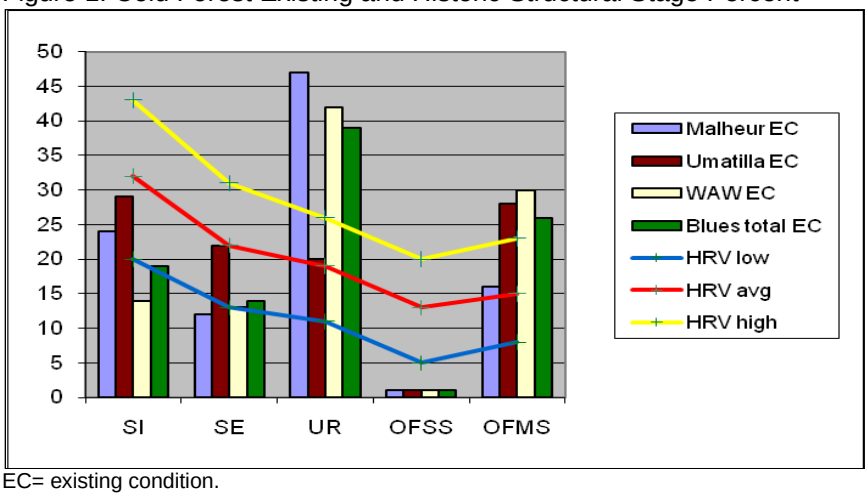
Our departure analysis summarizes the departure between our estimates for historic conditions and our measured existing condition. **Although HRV may not necessarily be a target, especially if current factors preclude re-establishing historic conditions; research in ICBEMP has shown that the further deviated you are from HRV, the lower the likelihood that you will have species sustainability.** Our departure analysis is formatted to be consistent with methodology currently used in assessing projects in relationship to the Eastside Screens, but will also be useful as we move ahead with Forest Plan Revision. Departure indices were generated for each potential vegetation group regardless of total extent of the type. Departure estimates for those types with limited extent should be used with caution.

Dry multi-story old forest (OFMS) is within HRV at the scale of the Blue Mountains, but varies from slightly above to within HRV when viewed at the scale of the individual national forest (Figures 1-5). Dry single-story old forest (OFSS) is below HRV, both at the scale of the Blue Mountains, and for each national forest. Multi-story old forests (OFMS) in cold and moist potential vegetation groups are generally within to above the HRV. Single-story old forest (OFSS) cold and moist potential vegetation groups also fall below HRV.

The stand initiation structural stage is slightly below to within HRV for most potential vegetation groups at the scale of the forest, but some individual watersheds in the dry and moist potential vegetation groups are above HRV due to recent large stand-replacement fires such as the School and Monument Fires.

The stem exclusion stage is generally within HRV but at the low range. The mid-age multi-story stage (understory reinitiation) is well above HRV for most potential vegetation groups.

Figure 1. Cold Forest Existing and Historic Structural Stage Percent



EC= existing condition.

Figure 2. Moist Forest Existing and Historic Structural Stage Percent

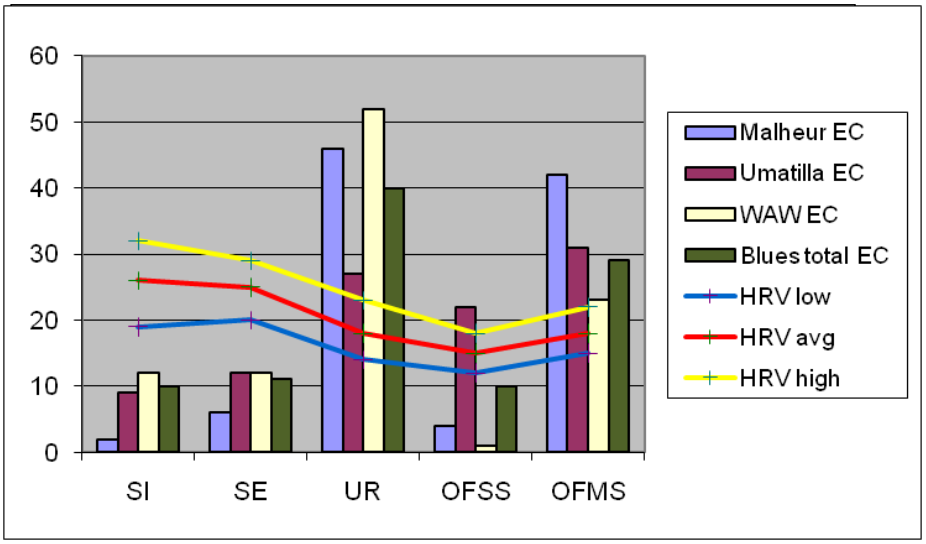


Figure 3. Dry Forest Existing and Historic Structural Stage Percent

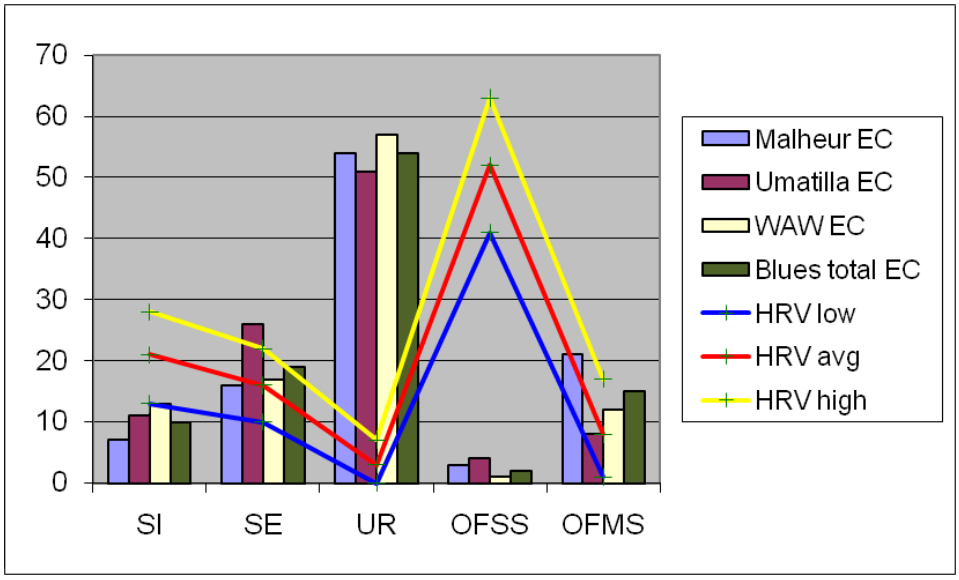


Figure 4. Old Forest Existing and Historic Structural Stage Percent for Open Canopy

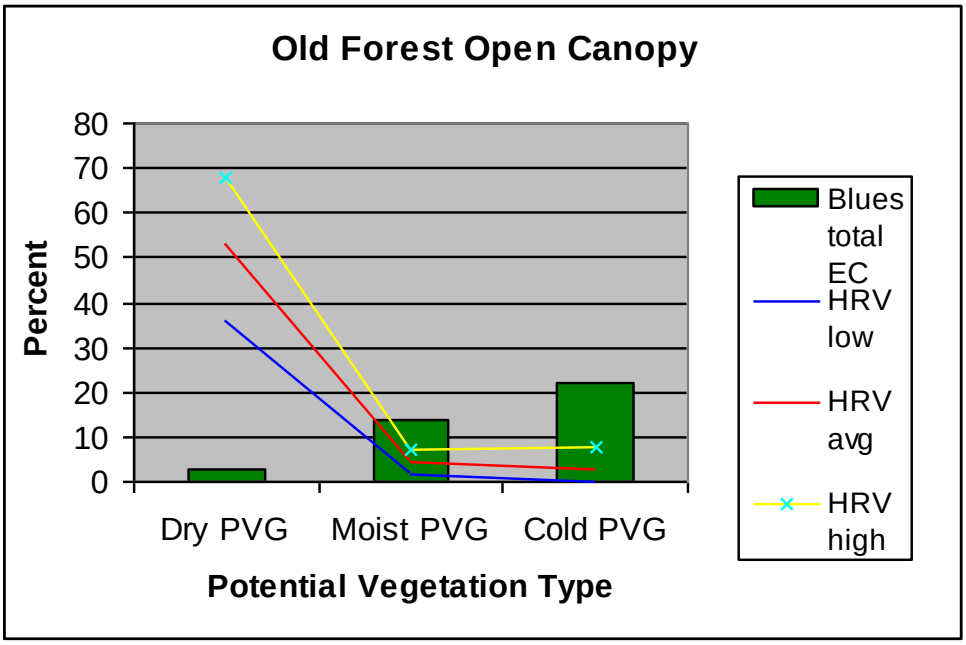
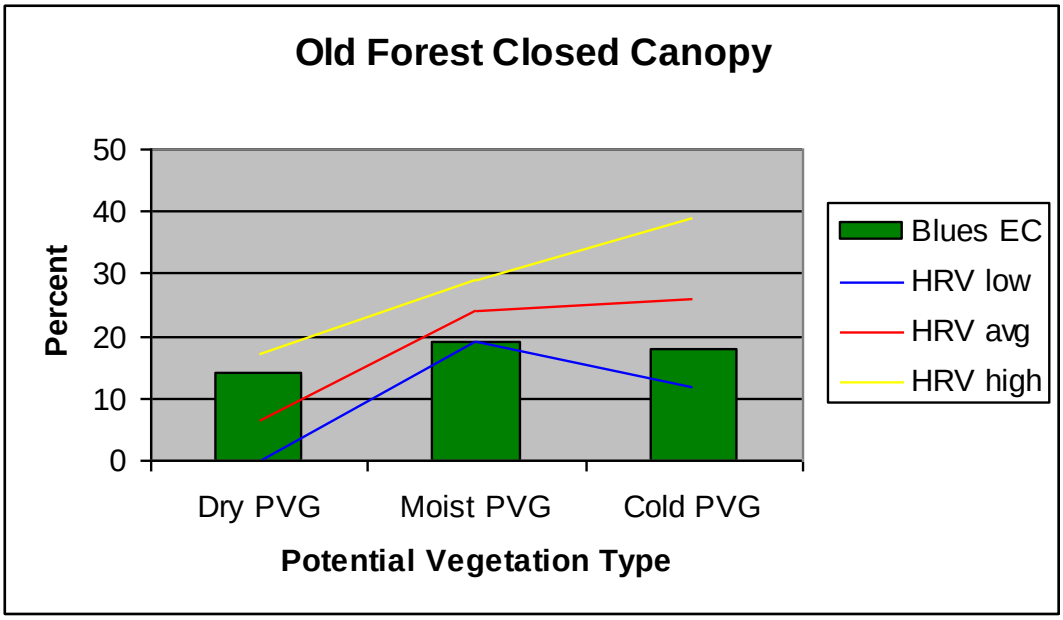


Figure 5. Old Forest Existing and Historic Structural Stage Percent for Closed Canopy



Comparison of Blue Mountains Forest Plan Results to Other Studies

HRV Estimates

In comparing our current screens HRV values to those developed with our new VDDT models, new levels of stand initiation are somewhat higher than our current (eastside screens) ranges. The new stem exclusion values are within range of the current ones. The mid age multi-story (UR) new values are at the low end of the current ranges we are using. New dry old single story

forest HRV values are generally higher than the current ones. Moist and cold single story old forest levels are slightly higher for new values. Dry multi-story forest new HRV values are within the current ranges. Moist and cold new HRV values for old multi-story forest are at the low end of the eastside screens values.

Caraher and others (1992) estimated that late seral park-like sites in the Blues historically occupied 30-50 percent of the landscape for moist sites and 70-80 percent for dry forests. Late seral multistory estimates ranged from 10-30 percent on dry sites, to 50-70 percent on moist sites.

Lemkuhl and others (1994) in the "Eastside Forest Ecosystem Health Assessment" estimated that historically (for the era of the 1930s) 10-15 percent of the landscape was in mature park-like structures.

Henjum et al (1994) in the "Eastside Forests Scientific Panel study" found that current levels of old growth forest, especially in the lower-elevation ponderosa pine, Douglas-fir, and Western larch types were far below historic levels. Their interpretation of historical accounts and old timber inventory records led them to believe that the dry forest historical landscapes might have contained as much as 80-90 percent old growth. They also estimated that the more moist Douglas-fir sites might have contained as much as 60 percent old growth.

Quigley et al (1997) in the "Assessment of Ecosystem Components in the Interior Columbia Basin" made modeling estimates of historic levels of structure within the Blues ecological reporting unit and found that dry old forest multi-story ranged from 12-19 percent, the single story estimate was 36-54 percent, mid seral was 20-29 percent, and early seral was 7-15 percent. Moist old forest single story was estimated at 11-24 percent, old forest multi-story was 15-28 percent, mid seral was 41-42 percent, and early seral was 20-21 percent. They made no estimate of the historic range for cold forest.

Hessburg et al (1999) in the "Historical and Current Forest and Range Landscapes in the Interior Columbia River Basin" mapped historic (approx 1930) levels of structure for the Blues ecological reporting unit for all forest types combined, and found that 13.7 percent of the forested area was comprised of old forest and other structural stages containing large trees. Significant reductions in old forest had probably already occurred by the 1930s date of aerial photography that this estimate was based on.

Morgan and Parsons (2000) developed estimates of HRV for Southern Idaho using VDDT models and found that old growth dry forest historically comprised 10-40 percent of the landscape. Large tree (12-20 inches DBH) estimates for dry forest ranged from 20-80 percent. Moist and cold forest estimates of old growth forest were generally less than 10 percent. Estimates of large tree condition (12-20 DBH) for moist and cold ranged from 5-25 percent. They made no estimates for the amount of closed versus open canopy forest.

Wisdom et al (2000) in "Source Habitats for Terrestrial Vertebrates of Focus in the Interior Columbia Basin" described both historical and current levels of habitat specific to each ecoregion in the Columbia Basin. Within the Blue Mountains ecoregion they estimated that historically 63 percent of the ponderosa pine cover type was old forest (50 percent single story and 13 percent multi-layer). The estimated old forest within the Subalpine fir and spruce cover type was 26 percent, with the entire total being multi-layer. The grand fir cover type (includes both moist and dry types) was estimated at one percent old single-story forest and 37 percent old multi layer forest.

Hessburg et al (2007) in research conducted primarily in eastern Washington suggests that old growth dry forest may not have been as abundant as previously thought, and that the landscape may have been dominated more by mid-age and young structures due to an abundance of mixed

severity wildfire and a lack of low severity fire induced equilibrium dynamics. Their estimate of the amount of old forest was about 10 percent of all structural stages.

Hemstrom (2007) found in INLAS modeling of the Upper Grande Ronde River subbasin that the cool/moist and cold forested environments historically didn't exceed 10 percent for the large tree classes. The total large tree class probably didn't exceed 25 percent for all types combined.

Wales (2007) used a very similar model to what we used and found that the cool moist group natural range of variability for medium and large trees (greater than 15 inches) was about 15 percent of the landscape, with 10 percent closed canopy and 5 percent open. The cold environment showed between 15-20 percent with most of that being closed canopy. Dry forest medium and large tree structure occupied approximately 50 percent, with most of that being open canopy

In summary (also see Table 6), while the range of estimates for historic levels of old dry forest made by others for the Blues varies from 10-90 percent, our forest plan estimate of 42-80 percent is well within the range of what several have found. Our estimate for moist old forest is 23-33 percent, which is also similar to what others have found.

Table 6. Percent old forest literature summary of HRV estimates

Percent Old Forest (HRV)						
Type	Average of dry moist and cold	Average Multi-story	Average single-story	Dry	Moist	Cold
Revision team HRV	-	-	-	42-80	27-40	13-43
Caraher	-	-	-	70-80	30-50	-
Lemkuhl	10-15	-	-	-	-	-
Henjum	80-90	-	-	-	60	-
Quigley	-	-	-	48-75	26-52	-
Hessburg	14	-	-	-	-	-
Morgan	-	-	-	10-40	<10	<10
Wisdom				63	38	26
Hessburg 2007	10	-	-	-	-	-
Hemstrom	25	-	-	-	<10	<10
Wales (trees > 15 DBH)				50	15	15-20

Existing Condition Estimates

Henjum et al (1994) in their Eastside Scientific Panel assessment estimated that currently there was approximately 600,000 acres of old growth forest outside of wilderness. This is equivalent to 14 percent of the forested lands in the Blues. Adding in old forest within wilderness would bring their total to about 20 percent.

Quigley et al (1997) made estimates of current levels of structural stages for the Blue Mountains ecological unit for several potential vegetation types including moist and dry forest. They made no estimates for cold forest. For dry late seral (old forest) they found that the current level was 32 percent (31 multi layer and 1 percent single story). Mid seral was 47 percent and early was 21 percent. The total old moist forest was 38 percent (14 single story and 24 multi story). Early seral moist was 34 percent and mid seral was 28 percent.

Hessburg et al (1999) in a sampling of subwatersheds within 6 subbasins in the Blues estimated the existing amount of area in old forest and other forest structures containing old trees to be 6 percent.

Wisdom et al (2000) estimated current levels of structural stages based on the tree species currently dominating the site. Within the Blues ecological reporting unit they estimated the current level of all old forest multi-story to be 28 percent and single story at 4 percent. They also found that current levels have been reduced from historical amounts by close to 100 percent for old dry single-story ponderosa pine forest. Old multi-story pine was reduced by 15 percent. The current level of single-story ponderosa forest was estimated at 3 percent, and multi-story was 17 percent. The changes are based on the absolute change in area as expressed in relative percent. Single-story larch and whitebark pine old forests also had large decreases. Multi-layer old forest whitebark pine, and western larch were found to have decreased by 100 percent. Englemann spruce-subalpine fir, Douglas-fir, grand fir multi-layer old forest showed increases of close to 100 percent relative change. Grand fir old forest single-story was estimated to be at four percent and multi-story at 40 percent. Englemann spruce and alpine fir was at zero percent for old single-story forest and 27 percent for multi-story old forest. Douglas-fir was at three percent for old single-story forest and 35 percent for multi-story. Grand fir, ponderosa pine, Englemann spruce-subalpine fir, Douglas-fir, and lodgepole pine showed large increases in the amount of managed and unmanaged young forests.

Christensen et al (2007) utilized current inventory survey (CVS) plot data and classified 21 percent of the Umatilla forested stands as greater than 20 inches DBH. The next highest category was for stands classified as 9-20 inches (69 percent). The largest percent of stands greater than 20 inches DBH were those dominated by grand fir, followed by ponderosa pine and Douglas-fir. This information was based on inventory data collected between 1997 and 2005.

Table 7. Percent old forest literature summary of existing condition

Percent Old Forest						
Type	Average of dry moist and cold	Average Multi-story	Average single-story	Dry	Moist	Cold
Blues EC	23	20	3	17	39	27
Henjum	20	-	-	-	-	-
Quigley	-	-	-	32	38	-
Hessburg	06	-	-	-	-	-
Wisdom	32	28	4	20	38-44	
Christenson	21	-	-	-	-	-

In summary (See Table 7) our existing amount of all old forest in the Blues (National Forest System lands only) is estimated by the revision team to be 20-25 percent of the forested area, which is close to the 15-20 percent estimated by Henjum and 21 percent estimated by Christensen for the Umatilla. Our estimate is lower than the 32 percent estimated by Wisdom, and higher than the 6 percent estimated by Hessburg. Dry old forest in the Blues is currently estimated at 17 percent using the forest plan revision existing vegetation data; this compares to 32 percent estimated by Quigley and 20 percent by Wisdom for ponderosa pine. Our estimate for moist old forest in the Blues is 33 percent; which compares to 38 percent estimated by Quigley and 44 percent by Wisdom for the grand fir cover type (the grand fir type includes both dry and moist types). Although there are some differences in the sets of data, the general trends that most others have found for currently greatly decreased levels of old dry forest, slightly decreased to stable levels of old moist forest, and increased levels of mid age multi-story stands for most vegetation types; are also trends that our local Blues data confirms.

Use of this Analysis for Site-specific Project-level Work

This analysis provides the most current evaluation of structural stages at multiple scales within the Blues. Site specific project level analysis teams can use this data to identify areas where treatments are appropriate to move landscapes closer to the desired mix of structural stages.

The classified data for structural stage and potential vegetation group of each vegetation polygon in the Blues, as well as acre totals and departure estimates by watershed, are located within the Blue Mountain forest plan revision GIS space. GIS coverages of the intersected vegetation polygon and watershed boundaries are also in the revision GIS space. The data tables of departure by watershed can be linked to the vegetation maps and other GIS layers, such as current management areas, to facilitate spatial identification of potential opportunities. The Revision Team GIS specialist can be contacted for access to the maps and data tables.

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Appendix A – Potential Vegetation Group Descriptions

See spreadsheet

Appendix B – Structural Stage Query Parameters

Old Forest**							
Structure	Cover type	Overstory Canopy closure	Overstory Trees per ac *	Over-story Size class	Over-Story DBH	Understory canopy	# layers
OFMS	LPP	>=20	60	>=77	12	>=10	>=2
OFSS	LPP	>=20	60	>=77	12	<=10	1
OFMS	AF, WBP	>=10	10	>=77	13	>=10	>=2
OFSS	AF, WBP	>=10	10	>=77	13	<=10	1
OFMS	ALL OTHERS*	>=10	>=10	>=9	>=21	>=10	>=2
OVSS	ALL OTHERS*	>=10	>=10	>=9	>=21	<=10	1

LPP = lodgepole pine, AF = alpine fir, WBP= whitebark pine
OFMS= old forest multi story
OFSS= old forest single story

*For cool very moist, warm very moist, or warm moist PAGs use dbh>=21 and TPA>=20, or size class >=9 and canopy closure >=20. See detailed listing of FVS structural stage keyword parameters by plant association for large tree and TPA requirements.

** Old forest parameters derived from the 1992 Region 6 Green Book Old Growth Definitions.

Non-Old Forest (dry, moist, cold forest)							
structure	Overstory Canopy closure	Total stand Canopy closure	Over-story Size class	Over-story DBH	Understory canopy	Under story size class	# layers
SI	>=10		<5	<5			
SI	<10		>=5	>=5	>=10	<5	
SI		<10	any	any			
SE	>=10		>=5	>=5	<10		1
SE	<10		>=5	>=5	>=10	>=5	1
UR	>=10		>=5	>=5	>=10		2
UR	<10		>=5	>=5	>=10		2
YFMS	>=10		>=5	>=5	>=10		3

SI= stand initiation, SE= stem exclusion, UR= understory reinitiation
YFMS= young forest multi-story

Appendix C –